MULTIFUNCTIONAL UTILIZATION OF AGRICULTURAL LAND FOR BIONERGY PRODUCTION IN CONTEXT OF ECONOMY'S FOOD SATISFACTION LEVEL

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ABSTRACT

The main role of agriculture production in economy is to produce food commodities in order to ensure the food safety. In this context agriculture ensures the production function.
The European Union in context of The European model of multifunctional agriculture declares the multifunctional agriculture land utilization. The one of the alternative multifunctional agriculture land utilization is the alternative land utilization for non-food bioenergy production. From the viewpoint of production input, agricultural land is the main production input for food and also non-food crop commodities. There are different approaches from domestic and foreign authors about food versus non-food energy agricultural land utilization. The main discussed fact is the limited character of agricultural land. Already in ideas of classic economist the land has been considered as limited production source.
The main goal of the article is to determine the potentially available agriculture land for energy crops cultivation in context of multifunctional agricultural land utilization at required food suffiecient level in Slovak economy. The multiple regression model is applied in order to model the agriculture land area available for non-food bioenergy production at different food satisfaction levels. The model is used to determine the available potential of cereal cultivated most productive agricultural land, which is primary utilized for main food production and secondary according to model scenarios could be potentially available for non-food biomass production. Cereals are the main food commodities in and also are considered to be one of the main food commodities cultivated as energy commodities in conditions of Slovak Republic suitable for biofuels production. We assume: a) primary with food agricultural land utilization - especially most productive land for main food commodities cultivation and b) secondary with potential alternative non-food biomass cultivation on surplus of agricultural land, after reaching the required food satisfaction level of economy.
In context of the Model of multifunctional agriculture we consider with two main factors limiting the availability of biomass sources from agriculture – the food satisfaction level of the economy and the multifunctional utilization of agricultural land as the main production factor of energy non-food biomass cultivation. According to The Agrarian and food policy of Slovak Republic the food satisfaction level is at minimum level of 90 %.

1. INTRODUCTION

Several programs deal with future position of agriculture sector assumes wider range of function for agriculture sector as its primary food production function. According to foreign and domestic studies the significant will be the position of the agricultural sector as a producer of renewable bioenergy sources. Renewable energy sources as a part of energy mix are considered to be the one of the basic pillar of sustainable economy.

These energy sources can gain strength at strategic level also in Slovak Republic, because of the Slovak economics' high level of energy dependency and vulnerability on imported fossil fuels. And also because of the availability of production potential of agricultural land (Bohunická and Židek 2005, Pepich 2006,).
Slovak Republic as a member of European Union deals with the question of renewable energy resources at national level. And also commit to expand utilization of bioenergy sources and increase of energy efficiency at national level.
The European Union in context of The European model of multifunctional agriculture declares the multifunctional agriculture land utilization. The one of the alternative multifunctional agriculture land utilization is the alternative land utilization for non-food bioenergy production. Biomass production is the one of the six main land function declared in context of multifunctional and intersectional land meaning. According to The Land government of Slovak Republic (2001) agriculture biomass as the one of the renewable energy resources from agriculture is divided into three basic groups:

- Biomass for heating – straw, wood waste biomass
- Bimoass for biogas – animal or crop sources, waste from food industry
- Liquide biofuels – crops for MERO production

According to FAO Studies (2006) support of the biofuels could be the opportunity for development of countries with considerable agricultural resources. Halliday (2007) emphasizes, that the development of biofuels is suppose to be the main factor causes increase in prices of agricultural commodities. The conclusion is the knock-on effect on food prices all over the world. Jonk (2007) and European Biomass Industry Association – EUBIA (2007) allege in studies that the potential of biofuels is low and limited because of the limited agricultural land for "fuels commodities" cultivation. A key uncertainty according to IEA (2007) is the availability of sufficient land resources for large-scale expansion of the cultivation of biofuel crops, given the intense competition with conventional agricultural products for arable land. Competition will favor those crops most profitable for farmers, accounting for such factors as growing region, farming practice, and soil type. According to authors, crops for non-food energy utilization would be cultivated primarily on lands situated in:

- marginal areas and areas contaminated with emissions (Váňa, 2003)
- degraded areas and also the available land can be gained by increasing of agriculture productivity (Bindraban and Cojnin, 2007)
- areas where the cultivation of food commodities was stooped because of economic reasons (Piczalka, 2007)
- Also there is a possibility to utilize the most productive agriculture land especially for alternative traditional food commodities cultivation, utilization of secondary commodities and waste (Jamriška and Surovčík, 2006)

The main goal of the article is to determine the potentially available agriculture land area for energy biomass production in context of multifunctional agricultural land utilization at required food sufficient level for Slovak economy. The partial goal is to give an overview of multifunctional agriculture land utilization from the viewpoint of food and non-food bioenergy crops cultivation. The multiple regression model is applied in order to model the agriculture land area available for food or non-food bioenergy utilization at different food sufficient levels. The model is used to determine the available potential of cereal cultivated most productive agricultural land, which is primary utilized for main food production and secondary according to model scenarios could be potentially available for energy biomass production.

2. MULTIFUNCTIONAL AGRICULTURE LAND UTILIZATION FOR FOOD AND NON-FOOD BIOENERGY CROPS CULTIVATION

The one of the alternative multifunctional agriculture land utilization is the alternative land utilization for food and non-food bioenergy crops cultivation. From this viewpoint agricultural land is the main production input for food and also non-food energy crop commodities. The production input – the area of agricultural land is limited. The basic principle of the multifunctional agricultural model, which is also the strategic base of The Slovak Agrarian and Food policy, is to ensure the food safety. In order to ensure the food safety is necessary utilize the part of agricultural land only for strategic direct food production utilization. On condition that the economy's food sufficient level is ensured, there is a place for other than food agricultural land utilization.

In context of the Model of multifunctional agriculture we consider with two main factors limiting the availability of energy crops sources from agriculture:

a) the food sufficient level of the economy and
b) the multifunctional utilization of agricultural land as the main production factor of energy biomass cultivation.

Energy biomass commodities cultivated for specific energy reasons in context of food security can be divided into two groups:

- food energy biomass crops base on traditional food commodities
- non-food energy biomass crops – non-food energy alternatives of traditional food commodities and other specific energy commodities

The traditional food commodities - cereals, maize and rape are commodities especially considered being the energy crops with considerable share cultivated on agricultural area suitable for biofuels production in condition of Slovakia. These food commodities belong to basic strategic food commodities with a significant long term share on utilized agricultural land.
In order to fulfill the goals based on The Biofuels Directive, these food energy commodities should have to be utilized in context of food security because of their food importance.

According to domestic and foreign authors and specialist in this field of problematic:

- Energy biomass commodities belong to category of food agricultural commodities can be cultivated without considerable restrictions on agricultural land.
- And as we have mentioned in part of this article - Introduction there is also the possibility to utilize the most productive agriculture land especially for alternatives of traditional food commodities cultivation, utilization of secondary commodities and waste.

Figure 1 display, total energy utilized agricultural land area divided into two categories of energy crops in year 2007.

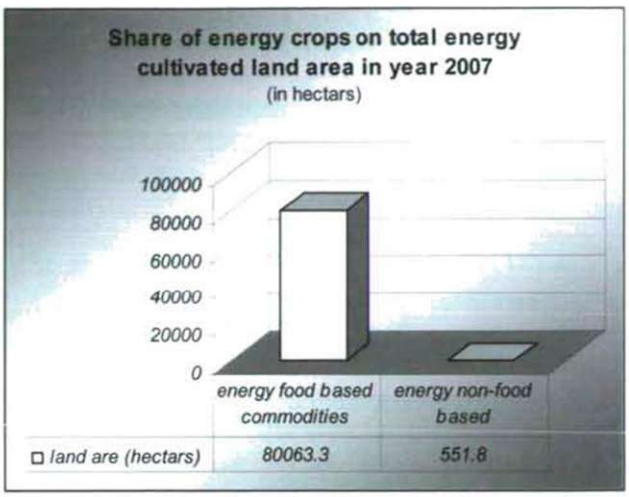

Figure 1. Share of food and non-food energy crops on total energy cultivated land area

Source: APA (2008), own calculation

The total energy utilized agricultural land area was aprox. 80,6 thousand hectares in year 2007.

- The significant 99.2% share on total energy utilized agricultural area had the food base energy commodities. The highest share on total energy utilized land area and also the most significant share in category of food energy commodities had the rape with 86 % share on total energy land area (cultivated on 69.9 thousand hectares of total energy cultivated area), followed by the maize with 12% share on total energy area (cultivated on 9.9 thousand hectares of total energy cultivated area). Other food base energy commodities including also cereals had less than 1% share on total energy cultivated land area.
- The share of the specific non-food energy crops (energy grasses, poplars, willows, and others) on total energy unitized land area was very low relatively less than 1% (cultivated on 551.28 hectares of total energy cultivated area). The share of individual non-food energy crops on total energy cultivated area was less than 1%.

2.1 Modeling of available potential of cereals cultivated on most productive agricultural land for energy utilization

The question is: *Are there potentially available land areas – especially the most productive agricultural land area for non-food energy utilization?*

- *In order to model availability of the most productive land area for energy utilization the land area of cereals were chosen as the land area represented the most productive agricultural land area*

- *There are some facts about cereals:*

- are cultivated on most productive agricultural land area and have character of intensive cultivated crop.

- in context of food security are the traditional main food commodities.
- are considered to be one of the traditional food commodities cultivated as energy crops in conditions of Slovak Republic suitable for biofuels production.
- The Agrarian and Food policy of Slovak Republic is based on principle of high food sufficiency level of cereals production.
- There is also the possibility to utilize the most productive agriculture land especially for alternatives of traditional food commodities cultivation (energy cereals) rather than other specific energy commodities.
- According to Figure 1, the share of cereals as a food base energy commodities are not significant (less than 1% share on total energy cultivated area) on total energy cultivated area - non-food utilization of cereals in domestic consumption is low

➢ *In consequences of utilization of agricultural land area restrictions we assume*:

a) primary with food agricultural land utilization - especially most productive land for traditional basic food commodities cultivation important for food security and
b) secondary with potential alternative food or non-food energy biomass cultivation on surplus of agricultural land, after ensuring the required food satisfaction level of economy.

➢ *The food security restriction expressed by the required food satisfaction level* - According to The Agrarian and Food policy of Slovak Republic the food satisfaction level is at minimum 90 % level of covering the domestic consumption from domestic production

The multiple linear regression model for cereals cultivated most productive agricultural land area:

Model 1

$$Y_{\text{food satisfaction level of economy}} = -56.003 + 22.836 * \text{yields} + 0.0001 * \text{land area}$$

Coefficient of determination R square = 0,734 (73.4 %), Significance F=0,0026 (F< 0,01)
The scenarios are based on different levels of cereals yields in order to model available agricultural land area for secondary non-food energy utilization.

- *Scenario A:* is based on the average level of cereals yields 5.2 $t.ha^{-1}$ in years 1985-1989. These yields represent the highest level of cereals yields have been reached in cereal cultivation in Slovak Republic.
- *Scenario B:* is based on and represent very low level of cereals yields at level of *2.7* $t.ha^{-1}$ in year 2000. The level of cereals yields was low particularly because of unfavorable climatic conditions
- *Scenario C* : is based on level of the highest estimated cereal yields at level of *4.5* $t.ha^{-1}$ in year 2010
- *Scenario D*: is based on level of the lowest estimated cereal yields at level of 2.5 $t.ha^{-1}$ in year 2010.

Table 1. The potentially available agricultural land area for non-food energy utilization according to different scenarios of cereals yields

Food satisfaction level of economy (%)	Available agricultural land area according to diffrent scenarios of cereals yields (hectars)			
	Scenario A	Scenario B	Scenario C	Scenario D
70	487472	-81144,4	327620	-129100
80	387472	-181144,4	227620	-229100
90	**287472**	-281144,4	**127620**	-329100
100	187472	-381144,4	27620	-429100
110	87472	-481144,4	-72380	-529100
120	-12528	-581144,4	-172380	-629100
130	-112528	-681144,4	-272380	-729100

Source: own calculations

According to modeling scenarios shown in Table 1, there are potentially available agricultural most productive land areas for non-food utilization only in cases of Scenarios A and C at the minimum of 90% food satisfaction level of Slovak economy. This potentially available land area could be secondary utilized for energy plants cultivation.

Note, in both scenarios A and C the estimated cereals yields are at the highest level. As less the level of food satisfaction is required in economy there is the higher available land potential for non food energy utilization.

In case of Scenarios B and D the most productive agricultural land areas for another than primary food utilization are not available. From another point of view in these scenarios non food utilization of most productive agricultural land would be available only in case of the competition with food production and food security.

3. CONCLUSIONS

One of the main discussed facts about food versus non-food energy agricultural land utilization is the limited character of basic production input the agricultural land. Our approach to multifunctional agricultural land utilization respects several restrictions cause by multifunctional principle. Primary should have to be assumed with food agricultural land utilization - especially most productive land for main food commodities cultivation and secondary with potential alternative non-food biomass cultivation on surplus of agricultural land, after reaching the required food satisfaction level of the economy.

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